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Reconnaissance Geologic Map of the Lane Mountain 7.5' Quadrangle, Oregon

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Introduction

The Lane Mountain 7.5 minute quadrangle is situated at the junction of three major geologic and tectonic provinces the northernmost Klamath Mountains, the southeastern part of the Oregon Coast Ranges and western part of the Cascade Range (Figure 1). Rocks of the Klamath Mountains province that lie within the study area include ultramafic, mafic, intermediate and siliceous igneous types (Diller, 1898, Ramp, 1972, Ryberg, 1984). Similar rock associations that lie to the southwest yield Late Jurassic and earliest Cretaceous radiometric ages (Dott, 1965, Saleeby, et al., 1982, Hotz, 1971, Harper and Wright, 1984). These rocks, which are part of the Western Klamath terrane (Western Jurassic belt of (Irwin, 1964), are considered to have formed within an extensive volcanic arc and rifted arc complex (Harper and Wright, 1984) that lay along western North America during the Late Jurassic (Garcia, 1979, Garcia, 1982, Saleeby, et al., 1982, Ryberg, 1984). Imbricate thrust faulting and collapse of the arc during the Nevadan orogeny, which ranged in age between about 150 to 145 Ma in the Klamath region (Coleman, 1972, Saleeby, et al., 1982, Harper and Wright, 1984) was syntectonic with, or closely followed by deposition of the volcano-lithic clastic rocks of the Myrtle Group. The Myrtle Group consists of Late Jurassic and Early to middle Cretaceous turbidity and mass flow deposits considered to be either arc basin and/or post-orogenic flysh basins that were syntectonic with the waning phases of arc collapse (Imlay, et al., 1959, Ryberg, 1984, Garcia, 1982, Roure and Blanchet, 1983). The intermediate and mafic igneous rocks of the Rogue arc and the pre-Nevadan sedimentary cover (the Galice Formation, (Garcia, 1979)) are intruded by siliceous and intermediate plutonic rocks principally of quartz diorite and granodiorite composition (Dott, 1965, Saleeby, et al., 1982, Garcia, 1982, Harper and Wright, 1984). The plutonic rocks are locally tectonized into amphibolite, gneiss, banded gneiss and augen gneiss. Similar metamorphic rocks have yielded metamorphic ages of 165 to 150 Ma (Coleman, 1972, Hotz, 1971, Saleeby, et al., 1982, Coleman and Lanphere, 1991)

The Jurassic arc rocks and sedimentary cover occur as a tectonic outlier in this region (Figure 2) as they are bound to the northwest and southeast by melange, broken formation and semi-schists of the Dothan Formation and Dothan Formation(?) that are considered part of a Late Mesozoic accretion complex (Ramp, 1972, Blake, et al., 1985) The plutonism that accompanied arc formation and tectonic collapse of the arc does not intrude the structurally underlying Dothan Formation, indicating major fault displacements since the early Cretaceous. Semischistose and schistose rocks of the accretion complex have yielded metamorphic ages of around 125-140 Ma where they have been studied to the southwest (Coleman and Lanphere, 1971, Dott, 1965, Coleman, 1972). These rocks were unroofed and unconformably overlain by marine deposits by late Early Eocene time (Baldwin, 1974).

The early Tertiary history of this region is controversial. The most recent interpretation is that during the Paleocene and early Eocene the convergent margin was undergoing transtension or forearc extension as suggested by the voluminous extrusion of pillow basalt and related dike complexes (Wells, et al., 1984, Snavely, 1987). This episode was followed shortly by thrust and strike-slip faulting in the late early Eocene (Ryberg, 1984).

During the Eocene, the Mesozoic convergent margin association of arc, clastic basin, and accretion complex was partly unroofed and faulted against early Cenozoic rocks of the Oregon Coast Ranges (Ramp, 1972, Baldwin, 1974, Champ, 1969, Ryberg, 1984). Faults that are typical of this period of deformation include high-angle reverse faults with a very strong component of strike-slip displacement characterized by the low-angle rake of striae. Thrust and oblique-slip faults are ubiquitous in early Tertiary rocks to the northwest (Ryberg, 1984, Niem and Niem, 1990).

The late Mesozoic and early Cenozoic arc and forearc rocks are unconformably overlain by the Late Eocene and younger, mainly continental fluvial deposits and pyroclastic flows of the Cascade arc (Peck, et al., 1964, Baldwin, 1974, Walker and MacLeod, 1991). Minor fossiliferous shallow marine sandstone is locally present. The volcanic sequence consists of a homoclinal section of about 1 to 2 kilometers of andesitic to rhyolitic flows and ash flow tuff. The section is gently east-tilted and is slightly disrupted by NE trending faults with apparent normal separation.

Previous Work

The first major geologic study of the Roseburg and adjacent areas was carried out by Diller (1898) and Wells and Peck (1961) who mapped the basic geologic framework of the region. More detailed mapping relevant to this map area was carried out through a concerted effort at University of Oregon, Eugene under the direction of E.M. Baldwin that resulted in the completion of three Masters theses (Hixson, 1965, Champ, 1969, Seeley, 1974) which helped refine major unit boundaries (See index to geologic mapping). The map area included in the regional compilation of Douglas County by Ramp and Beaulieu (Ramp, 1972) was primarily generalized from Diller (1898). Ryberg (1984) and Niem and Niem (1990) provided major regional tectonic syntheses concerning the evolution of early Tertiary sedimentary rocks of the region.

This study was undertaken as part of a contribution to 1:100,000 mapping of the Roseburg 30' x 60' quadrangle. Field studies were made during the middle summer months of 1992 and 1993. The mapping was greatly facilitated by the numerous logging roads that lace the national forests lands, otherwise heavy vegetation and deep weathering of the region would have limited access to rock exposure.

There are several important modifications to the regional mapping (Walker and MacLeod, 1991) that have resulted from this investigation.

The nature of the contact relations between the major units within Klamath lithologies has been investigated in greater detail and were found to be dominantly major fault zones, and commonly normal faults. The sense of displacement on the major bounding structures was given careful attention. Many high-angle normal faults cut low-angle thrust faults that are interpreted as Nevadan in age. There were no depositional contacts between Myrtle Group rocks and plutonic rocks evident in the field, likewise the abundant conglomerates of the Myrtle Group were devoid of intermediate plutonic clasts. Similarly the contacts between Rogue volcanic and hypabyssal rocks were characterized by semi-ductile to cataclastic fabrics of low greenschist facies that were generally devoid of silicification, siliceous veins or aplitic dikes suggesting the contacts are faults and the faults were post-plutonic. The major structural boundary between the Rogue arc complex and structurally underlying rocks includes a variety of ductile high strain rocks, schists and semi-schists that occur within a kilometer or two wide zone that is low-angle, east-dipping and west-verging.

Stratigraphy

The rocks of the area can be separated into four major sequences that are characteristic of the tectonic provinces they represent. From oldest to youngest, as described above are the Late Jurassic Rogue arc complex including a younger plutonic complex, an unmetamorphosed cover sequence that is stratigraphically equivalent to the Great Valley sequence; the melange, broken formation and semi-schists of the Late Mesozoic accretion complex represented by the Dothan Formation; the Paleocene and early Eocene forearc basin deposits; and lastly, the Late Eocene to Miocene? rocks of the western Cascade volcanic arc.

The Rogue arc complex consists of an igneous complex that includes predominantly hornblende gabbro, hornblende diorite, and diabase rocks that are commonly slightly to strongly foliated. The extrusive part of the complex is characterized by quartz keratophyre, keratophyre, plagioclase porphyry flows, pillows, hypabyssal dikes and flows, flow breccia, and minor tuffaceous sedimentary rock. These rocks are commonly tectonically brecciated and have undergone low to moderate greenschist facies metamorphism. They are locally intruded by quartz diorite, granodiorite and similar siliceous plutonic rocks that are generally unfoliated or weakly foliated near the margins. Metamorphosed country rock that was gabbroic to intermediate in composition is locally preserved; however, along many contacts the primary intrusive contact between the 'older arc' and younger siliceous plutonic rock is obscured by faults that are interpreted as low-angle normal faults.

The Rogue arc complex is unconformably overlain by unmetamorphosed clastic rocks of the Myrtle Group which includes the Riddle and Days Creek Formations that in this area range in age from lowest Cretaceous (Berriasian) to Late Albian. The basal part of the section includes tuffaceous sedimentary rocks and volcanic breccia suggesting that deposition was in part coeval with arc volcanism. Conglomerates in the lower part of the section are rich in mafic to intermediate volcanic clasts and dark chert or cherty tuff, and lack any significant component of plutonic rock. In contrast, plutonic clasts are quite abundant in conglomerate within the basal Tertiary section in the quadrangle.

In the Lane Mountain quadrangle there are only thin fault slivers of metagraywacke which are continuous with the more regionally extensive belt of Dothan Formation. The Dothan Formation is considered to be part of a subduction-accretion complex that formed during latest Jurassic and Cretaceous time (Ryberg, 1984, Blake, et al., 1985).

Sedimentary rocks of the Oregon Coast Ranges are represented by exposures of the Eocene White Tail Ridge Formation (Ryu, et al., 1992) that are present in the northwest corner of the quadrangle. The White Tail Ridge Formation consists of shallow marine, cross-bedded and massive planar bedded, fossiliferous sandstone and mudstone. These rocks are part of a regionally extensive sequence of submarine fan to nonmarine fluvial deposits that ranges from Paleocene to middle Eocene age (Ramp, 1972, Baldwin, 1974, Ryberg, 1984, Niem and Niem, 1990, Ryu, et al., 1992). These rocks are considered to have been deposited in a forearc basin setting during the early Tertiary.

Rocks of the western Cascade Province consist of a basal sedimentary unit, the Colestin Formation of (Peck, et al., 1964, Baldwin, 1974), that represents a transition between shallow marine and fluvial conditions. The clastic rocks at the base of the section generally fine towards the north. In the southeastern part of the map area, the basal section is characterized by cobble conglomerate, whereas to the north it consists of fine-grained sandstone, siltstone and shale. The unit also generally becomes finer-grained up section. The Colestin is overlain by a regionally extensive, generally chaotic unit that is olisostromal and lahar-like in character with abundant blocks of andesitic volcanic rock as well as disrupted and slumped sedimentary rock. This unit heralds the arrival of voluminous andesitic and dacitic flows and breccias that are followed by several cooling units of rhyolitic, moderately welded ash flow tuff making up approximately half of kilometer of section. The rhyolitic ash flow tuffs are locally capped by a pyroxene-phyric andesite. The volcanic units have previously been mapped as part of the Oligocene Little Butte Volcanic Series (Peck, et al., 1964, Ramp, 1972).

Generally northwest trending basaltic to andesitic dikes can be found cutting the Mesozoic plutonic rocks and well as the Cenozoic rocks up through the rhyolite unit 1. Such dikes could range in age form Eocene to Miocene, however are generally considered to be of Oligocene age in this area (Walker and MacLeod, 1991).

Structure

The structural grain of the region, as well as this quadrangle, is strongly dominated by north 30 to 40 east trending faults and lithologic belts. The faults represent upper- and middle-crustal brittle structures including high-angle reverse faults and associated overturned folds; deeper-seated north-west verging brittle and ductile shear zones within the plutonic complex; and high-angle faults with apparent normal separation that drop unmetamorphosed rock of the Mesozoic forearc basin, as well as the Tertiary Cascade arc rocks down against the plutonic complex. Many of the low-angle contacts between the Rogue arc complex and underlying plutonic rocks are interpreted as low-angle normal faults.

The contact between rocks of the Jurassic Rogue arc complex and the underlying siliceous plutonic rocks is typically characterized by a broad zone of cataclastic deformation, the hanging wall and foot-wall rocks are commonly strongly foliated as well. Mineralization associated with this deformation is typically of the lower greenschist facies with abundant secondary epidote, albite and pumpellyite. These faults and breccias zones are not invaded by magmatic fluids suggesting they are not syntectonic with the plutonism but were subsequent. The structural pendants of Rogue arc are locally strongly hydrothermally altered. Leaching of the mafic phases is common, particularly adjacent to the high-angle normal faults. The high-angle normal faults are locally characterized by broad breccia zones and more rarely by intrusion of Tertiary andesitic and basaltic dike rocks. Siliceous quartz diorite dikes are found locally within the extrusive and intrusive parts of the Rogue complex. Such dike rocks have not been observed in the overlying Mesozoic sedimentary rocks.

In the NW part of the Lane Mountain quadrangle, a major northeast trending zone of imbricate thrust faults emplaces the Rogue arc complex and associated rocks over the Dothan complex. The igneous complex is locally overturned and in the adjacent quadrangle to the west is pentratively deformed into strongly banded and foliated gneiss, augen gneiss and mylonitic rock along major northwest verging thrust faults.

Metamorphism

Regional, contact, and hydrothermal metamorphic rocks are present within the study area. Regional metamorphic rocks include low to moderate-grade greenschist facies rocks of the arc complex that are inferred to have formed during the Nevadan orogeny of Late Jurassic age. Metamorphic rocks that formed during this event; which represents imbrication of the Late Jurassic arc, include gneiss, banded gneiss, augen gneiss and mylonitic rocks that are inferred to have originated at middle crustal levels (Champ, 1969, Hotz, 1971, Garcia, 1982, Coleman and Lanphere, 1991). These rocks are typically upper greenschist and lower amphibolite facies.

Retrograde assemblages with epidote-pumpellyite and lower greenschist facies assemblages are commonly associated with cataclastic fabrics particularly near the major fault contacts which bound the arc complex units. This post plutonic semi-brittle deformation may be post-Nevadan and

Cretaceous in age. The cataclastic fabrics are inferred to have formed during extension associated with uplift and unroofing of the plutonic rocks.

In addition, low-grade schists and semi-schists of prehnite-pumpellyite facies are characteristic of the higher-grade accretion complex rocks of the Dothan Formation in this area. These rocks generally structurally underlie major thrust faults that have the Rogue arc complex in the hanging wall. Schists of the Dothan Formation are generally partially reconstituted meta-sedimentary rocks with a moderately developed pressure solution fabric and incipient development of chlorite, white mica, ± pumpellyite. Detrital tourmaline, epidote, biotite, muscovite, hornblende and pyroxene common constituents are common constituents of these rocks, but are not indicative of the metamorphic grade.

Hornfelsic hornblende gabbro rocks are locally present near the margins of large quartz diorite and granodiorite plutons. Hornfelsic rocks were also locally developed in Mesozoic country rock near one of the larger Tertiary dike intrusions. Hydrothermal alteration is widespread near high-angle faults that cut the Rogue volcanic rocks.

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DESCRIPTION OF MAP UNITS

Surficial Deposits divided into:

Qls **Landslide deposits (Holocene and Pleistocene?)**--Chaotic mixture of clay, silt, sand, gravel and boulders of weathered and fresh bedrock composition

Qal **Alluvial deposits (Holocene and Pleistocene?)**--Alluvial deposits consisting of unconsolidated or poorly consolidated; angular and sub-angular cobble, pebble, gravel, and sand sized clasts, poorly sorted commonly reddish or yellow orange weathering

Qfl **Fluvial deposits (Holocene and Pleistocene?)**--Fluvial deposits consisting of poorly sorted, well-rounded to subrounded; boulders, cobbles, pebbles, grit, sand, silt and clay sized unconsolidated material

Tdi **Tertiary intrusive (Miocene and/or Oligocene?)**--Dominantly glomero-porphyritic clinopyroxene phyric dikes with diabasic texture, ± plagioclase phyric phases, some dikes that cut Mesozoic basement and basal Tertiary section may be feeder dikes to Ta unit; some dikes also cut Tr1 unit locally; contact aureoles in Mesozoic rocks developed around largest of dikes

Little Butte Volcanic Series of Peck and others (1964) divided into:

Td **Pyroxene dacitic andesite (Oligocene?)**--Pyroxene porphyry dacitic-andesitic flow, abundant fresh interstitial clinopyroxene, larger pyroxene phenocrysts commonly altered to chlorite, weathers reddish, grayish where fresh

Tr1 **Rhyolite unit 1 (Oligocene?)**--Rhyolitic moderately to poorly welded ash flow tuff; white to pale gray weathering, quartz and plagioclase phyric, crystal rich, trace white mica and epidote, rare rounded and resorbed biotite, abundant opaques, mafic mineral generally badly altered, crystal tuff; approximately 120 meters thick

Tac **Andesitic conglomerate, diamictite, and volcanic breccia (Oligocene and/or Upper Eocene?)**--Polymict volcanic breccia, cobble conglomerate, dacitic and andesitic volcanic rocks; 0 to 120 meters thick

Ta **Andesite (Oligocene and/or Upper Eocene?)**--Andesitic rocks including amygdaloidal flow breccia, dominantly plagioclase porphyry plagioclase and pyroxene porphyry, massive andesitic flows, and flow breccia, locally columnar jointed; locally overlain by dacitic plagioclase phyric unit; approximately 120 to 180 meters thick

To **Olistostrome (Oligocene and/or Upper Eocene?)**--Lahar, olisostromal or mass flow diamictite unit; disrupted chaotically oriented blocks of sedimentary and volcanic rock; locally deposited concurrently with andesitic flows and flow breccia; approximately 60 meters thick

Tc **Colestin Formation (Upper Eocene?)**--Sedimentary and volcano-clastic rocks, basal sedimentary unit consists of boulder, cobble and pebble conglomerate sandstone and tuffaceous sandstone, pale whitish, orange and ochre weathering, well-rounded to subangular clasts of Klamath lithologies including schistose graywacke, Riddle Formation(?) pebble conglomerate, porphyritic volcanic rocks, chert, angular to subangular arkosic sandstone with little or no mica, and gritty-angular plutonic derived sandstone that resembles disarticulated, deeply weathered diorite; poorly consolidated, matrix supported, conglomerate; clasts commonly imbricated; marine fossils found at one locality, massive red sandstone with well-developed groove casts observed at one locality, generally shallow marine to nonmarine deposit, nonmarine facies predominate; approximately 300 to 400 meters thick

Twt **Umpqua Group, White Tail Ridge Formation (Lower Eocene)**--Conglomerate, pebble conglomerate sandstone and shale; thick-bedded, medium- to coarse-grained, mica-bearing lithic-feldspathic sandstone with minor interbedded mudstone; very dark lithic, friable, blue-gray looking coarse sandstone to grit; abundant diverse fauna that locally includes mollusks, gastropods, and echinoids; some coarse and carbonaceous plant-bearing siltstones. Some beds display large-scale trough cross-bedding, some planar bedded. Conglomerate is generally matrix supported. Clasts are rounded to well rounded, very poorly sorted, poorly to moderately-well graded beds; locally, large continuous burrows are present in olive-colored siltstone interbeds. Generally pale buff to orange weathering. Mainly marine upper fan to delta complex

Intrusive Complex

JKi **Intrusive rocks (Jurassic and/or Cretaceous)**--Granodiorite, quartz diorite, diorite and hornblende diorite, generally massive, unfoliated or only very weakly foliated, white weathering, very deeply weathered and commonly friable; uralized or weakly metamorphosed to lower greenschist facies; quartz diorite includes accessory apatite, sphene, trace white mica, green chlorite, and epidote. Green hornblende and biotite are the principal mafic phases. Quartz ranges from a few percent to about 30 percent

JKgd **Granodiorite (Jurassic and/or Cretaceous)**--White weathering, coarse and medium grained quartz, plagioclase, microcline, hornblende ± biotite bearing rock. Commonly static or unfoliated to very weakly foliated texture

JKhd **Hornblende diorite (Jurassic and/or Cretaceous)**--Medium to coarsely crystalline hornblende diorite composed of plagioclase, hornblende, minor or no quartz, and accessory magnetite, ilmenite, secondary epidote and chlorite

Metamorphic rocks

JKdt **Dioritie tectonized rock (Jurassic and/or Cretaceous)**--Strongly foliated cataclastically and ductilely strained dioritic rock; locally abundant dark mafic dikes that are boudined, lenticular or completely transposed into the foliation direction, strain fabric developed under moderate greenschist facies; biotite, chlorite and epidote are present in tension fractures and replacing igneous hornblende and plagioclase in foliation surfaces; this fabric locally overprinted by secondary silicification and metamorphism, JKhf **Mafic hornfels (Jurassic and/or Cretaceous)**--Hornfelsic silicified mafic intrusive rock. Generally very dense hard rock in contrast to the commonly deeply weathered nearby intrusive rocks. Locally very coarse crystalline pegmatic hornblende dikes nearby.

JKag **Augen gneiss (Jurassic and/or Cretaceous?)**--Strongly foliated, banded medium-crystalline rock consisting predominantly of hornblende-rich and plagioclase ± quartz rich layers. This rock appears to be tectonized hornblende diorite and quartz diorite that has undergone cataclasis and sub-mylonitic deformation.

Sedimentary Rocks overlying Klamath basement

Myrtle Group (Late Jurassic to middle Cretaceous)--Mudstone, sandstone and conglomerate of the Cretaceous Days Creek and Jurassic? and Cretaceous Riddle Formations. These units represent forearc or foreland mass flow and channel deposits that were deposited during the waning stages of the Nevadan orogeny or just following. The Riddle Formation locally unconformably overlies and is fault bounded with the Late Jurassic Rogue Volcanics

JKr **Riddle Formation (Late Jurassic? to Early Cretaceous)**--Well-bedded pebble to cobble conglomerate, volcanogenic sandstone and shale deposited by turbidity currents and mass flow processes; locally interbedded tuffaceous sedimentary rock and volcanic breccia near the base; conglomerate dominated by volcanic and dark chert rich clast types; unit is unmetamorphosed and moderately indurated; locally silicified with quartz veins near major faults, thin-bedded siltstone and shale slightly concretionary, mudstone-rich facies locally very fossiliferous and bioturbated. Conglomerate clasts are very well-rounded, poorly sorted and consist predominantly of mafic and felsic volcanic rock, dark to gray chert, diabase and volcanic sandstone; dark green-brown weathering. Contains abundant *Buchia uncitoides* of Lower Cretaceous, Berriasian age and possible *Buchia elderensis* or *piochii* of Upper Jurassic, Tithonian age (William Elder, Per. comm.)

Accretion Complex

JKd **Dothan Formation (Late Jurassic and Early Cretaceous)**--Slate, fine and medium grained metagraywacke, weakly to moderately foliated, zeolite to pumpellyite facies metamorphism, argillaceous mudstone, and minor pebble and cobble conglomerate. Graywackes are micaceous quartzofeldspathic to lithic composition. Regionally the unit contains blocks of accreted oceanic crust that includes greenstone, pillow basalt, radiolarian chert, and shallow marine algal limestone, pelagic foraminiferal limestone (Whitsett Limestone of Diller 1898) and blocks of metamorphic rocks including blueschist, metatuff, metachert and amphibolite. The Dothan is probably a post Nevadan highly folded trench and trench-slope basin deposit that was metamorphosed during the Cretaceous.

JKd2 **Dothan Formation Semischistose (Late Jurassic and Early Cretaceous)**--Slate, phyllitic siltstone, fine and medium grained metagraywacke, weakly to moderately foliated where thick-bedded, semi-schistose where thin-bedded, pumpellyite facies metamorphism, argillaceous mudstone with minor pebble and cobble conglomerate. Graywackes are micaceous feldspathic to lithic in composition, locally contains abundant detrital epidote, white mica, chlorite and lesser biotite, rare detrital quartzo-feldspathic clasts containing fine-grained euhedral brown hornblende; locally very orange-red weathering

Western Klamath terrane
Jurassic continental arc complexJ

rv **Rogue Volcanics? (Late Jurassic)-**-Extrusive and hypabyssal intrusive rocks of mafic and intermediate composition, commonly very fine grained aphyric or plagioclase-pyroxene porphyry, extrusive rocks commonly amygdaloidal, extremely rare thin-bedded intermediate and siliceous, thin-bedded, crystal-lithic, plagioclase phyric tuffs locally. Dense, dark green where fresh, weathers rusty, locally contains pillow and pillow breccia texture. Locally hydrothermally altered and leached of mafic constituents, also locally cut by dioritic dikes of the intrusive complex

Jri **Mafic intrusive unit (Late Jurassic?)**--Intrusive rocks, intermediate to mafic in composition including hornblende gabbro and hornblende diorite with subordinate quartz diorite, generally medium to coarse grained, metamorphosed to pumpellyite facies and lower greenschist facies. Commonly chlorite and epidote bearing. Unit tends to weather dark rusty red

Jrs **Serpentinized ultramafic rock (Jurassic?)**--commonly foliated dark to pale green serpentinized peridotite and serpentinite, where fresh weathers rusty, locally occurs in fault zones

Jrvs **Schistose Rogue Volcanics? (Late Jurassic)**--Extrusive and hypabyssal intrusive rocks of mafic and intermediate composition with penetrative cataclastic and/or schistose fabric, commonly very fine grained aphyric or plagioclase-pyroxene porphyry, extremely rare thin-bedded intermediate and siliceous, thin-bedded, crystal-lithic, plagioclase phyric tuffs locally. Dense, dark green where fresh, weathers rusty, locally contains pillow and pillow breccia texture; metamorphosed to pumpellyite facies and/or lower greenschist facies, epidote, chlorite, sphene-bearing assemblages

Jris **Schistose mafic intrusive unit (Late Jurassic?)**--Intrusive rocks, intermediate to mafic in composition including gabbro and diorite, minor quartz diorite, generally medium to coarse grained, metamorphosed to pumpellyite facies and/or lower greenschist facies, epidote, chlorite, sphene-bearing assemblages; penetrative cataclastic and or schistose fabric. Unit tends to weather dark rusty red

Map Symbols

Attitudes

Bedding: Inclined, vertical, horizontal

Bedding: Top direction known

Bedding: Overturned

Crumpled or disrupted bedding

Foliation: Inclined, vertical, horizontal

Foliation and Bedding: Inclined and vertical

Brittle or cataclastic foliation

Dike orientation: Inclined and vertical

Lineation

Overturned syncline, dashed where approximately located

Overturned anticline, dashed where approximately located

Contacts

Depositional contact: dashed where approximately located, dotted where concealed, queried where inferred

Fault, ball on down-thrown block, open arrow indicates dip where known, lineation symbol indicates rake of striae, dashed where approximately located, dotted where concealed, queried where inferred

Thrust fault, teeth on hanging-wall, dashed where approximately located, dotted where concealed, queried where inferred

Low-angle normal fault, dashed where approximately located, dotted where concealed, queried where inferred

Small faults with known dip

Strike-slip fault, paired arrows indicate relative displacement

Map No.	Sample No	Fossils Localities Fossil Name	Lane Mountain Quadrangle ** Age	Environment
1.	1 LM-92	*Brachiodontes cowlitzensis* *Nuculana sp.* *Venericardia sp.*	Paleocene—E Oligocene	
2.	4 LM-92	*Naticid genusindet* *? Brachiodontes sp.* indet. *? Macoma sp.* indet. *? Cadulus sp.* indet.		
3.	9 LM-92	*Turritella sp.* *Acanthocardia brewerli*	E. Eocene mid Eocene	20-185 meters
4.	10 LM-92	*Brachiodontes cowlitzensis?* *Glycymeris sp.* indet. *Microcallista convadiana*	L. Paleocene - Late Eocene	0-50 meters
5.	11 LM-92	*Turriletta sp.* indet *Acanthocardic brewerii* *? Corbula sp.* indet. *Microcallista convadiana* *? Venericardia sp.*	E. Eocene - late mid Eocene	20-185 meters
6.	12 LM-92	*Turritella sp.* indet. *Cadulus sp.* indet.		20-185 meters
7.	16 LM-92	*Turritella sp.* indet. *Acanthocardia brewerii* *Microcallista conradiana* *Dentalium sp.* indet.	E. Eocene - late mid Eocene	20-185 meters .
8.	92 LM-2	*Turritella sp.* indet. *Brachidontes cowlitzensis* *Microcallista conradiana*	L. Paleocene - L. Eocene	
9.	92 LM-10	*Fusunus sp.* indet *Acila (Truncacila) decisa* *Brachidontes cowlitzensis* *Clinocardium? sp* indet *Dentalium stentor* *Schizaster diabloensis*	late-early to early-middle Eocene	not deeper than 50m
10.	93 LM-3	*Buchia uncitodies*	Berriasian	
11.	93 LM-11	*Micrcallista conradiana* *Nemocardium sp.* indet	late Paleocene to late Eocene	20-180 meters post-mortum transport
12.	93 LM-12	*Cylichnina tantilla* *Turritella sp* .indet *Naticid genus* indet. *Brachidonts cowlitzensis* *Microcallista comradiana* *? Periploma sp.* indet. *Venericardia sp.* indet	Eocene	20-180m
13.	93 LM-19	*Buchia cf. piochii*	Middle?-Late Tithonian	
14.	93 LM-25	*Venericardia sp.* indet.		

****Terrtiary fossils identified by Loius Marankovich; Mesozoic fossils by Will Elder**